CASE STUDY 1

Material Handling and Storage Strategies for a Containerized Port

By

Trey Roady

Jorge Benavides

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"On my honor as an Aggie, I have neither given nor received unauthorized aid on this academic work."

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Submitted to fulfill the requirement for case study one.

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I. INTRODUCTION

The East Bay Terminal (EBT), as it currently stands, is rapidly losing its advantage in shipping and storage. Current increases in storage costs and decreases in available capacity threaten the long-term feasibility of EBT. Left unchecked, this inefficiency may lose ACME's container storage presence in Savannah, Georgia.

We at Integrity Engineering would like to remedy this situation. Our analysis provides several recommendations, which will boost EBT's performance, remove damaging public-era policies, and fulfill EBT's potential as a container shipping facility.

This analysis considers the annual cost of three separate storage methods: wheeled, top lifter grounded, and gantry crane grounded. Focus is placed on the current utilization of the facility, available storage solution costs and benefits, and possible process flow improvements to increase facility efficiency and demand capacity.

However, our scope does not include demand forecasting for the facility, operations revenue, or the specific facility layout. This is primarily due to the available detail of information. No clear forecasting trends were provided; therefore, any possible predictions for future capacity would be unfounded. Likewise, no data was given about the exact dimensions of the facility or the physical arrangement of storage areas.

II. BASELINE CALCULATIONS

A. COSTING ANALYSIS

The current setup being utilized by EBT is a mixed method between wheeled storage and gantry crane grounded storage. As can be seen, gantry cranes are much more effective in storage costs (**Appendix D.I & D.III**). These costs are reflected in *Table 1*. The gantry crane clearly has the advantage for 2-high and 3-high stacking costs, but wheeled maintains the relative cost advantage for 1-high storage. In short, the gantry crane is more cost effective if storage is kept stacked at least 2-high.

The current setup has one surprising issue: the gantry cranes are under-utilized. The current arrangement of cranes loses 224 containers worth of capacity (**Appendix E**). If these cranes were properly arranged almost all of the current demand could already be stored using gantry cranes *only.* These containers could otherwise be stacked in a 3-high configuration but are instead incurring wheeled cost. This leads to a loss of $19.00 *per container* for a total loss of $4,316.80 per inventory turnover, or $131,230.72 a year.

Table I: Cost per Container

	1-High	2-High	3-High
Wheeled	$37.89	-	--
Top Lifter	$65.17	$32.58	-
Gantry Crane	$56.67	$28.73	$18.89

B. PROCESS FLOW

Currently, transactions are charged the standard rate of $35.00 per container that transitions either from or to a ship. However, there is nothing charged for containers that both enter and exit through the gate. This allows the opportunity for other companies to use EBT as a free storage service.

Also, charges are only incurred for items as they enter or leave. As can been seen from the Container Pickup Schedule (**Appendix H**), 77% of containers are picked up after 5 days. Others continue to take up valuable storage space for up to another week.

III. NEW STORAGE DESIGN

A. TOP LIFTER GROUNDED STORAGE ANALYSIS

The top lifter is appealing for its simplistic approach to grounded storage. They cannot stack as deeply as the gantry crane, but that would appear to be a fair trade to avoid the large investment of a gantry crane. However, while the individual rows are fairly densely packed, the overall storage density is fairly comparable to wheeled storage because of the large top lifter maneuvering requirements. Without a density advantage, top lifters fail to reach cost efficiency compared to both wheeled and grounded storage.

I. ADVANTAGES/DISADVANTAGES

The top lifter financing and maintenance costs are $125,999.47 more than buying a gantry crane, and they also allow improvements over wheeled storage by stacking the containers 2-high. The cost per acre of operation for top lifters is less expensive than that of the yard-gantry crane, even if pavement repair must be done.

Conversely, only stacking containers 2-high heavily limits top lifter storage. The top lifters are the most expensive option in storage per container due to their lack of storage density. The columns themselves are efficient but require large areas of blank maneuvering space which make the top lifter undesirable.

II. COST ANALYSIS

The land cost of top lifter grounded storage for ACME would be $51,000.00 per acre-year. Utilizing finance with an interest rate of 7% and a 10-year period, each top lifter costs $300,000.00. Using the annual payment formula, the equipment cost per acre-year for EBT would come down to an intermediate subtotal of $122,713.00 per top lifter-year. Each top lifter purchased can service up to 6.3 acres. The maintenance cost of a top lifter is $45,000.00 per year and the operator cost is $35,000.00 per-year. Considering these together and implementing the present value formula again, each top lifter costs an additional $19,478.28 per acre-year. Calculating the total cost of each acre using a top lifter would total $70,478.25. ACME's cost per container using top lifter would be $66.07 if stacked 1-high and $33.04 if stacked 2-high with no availability for 3-high stacking. Please reference **Appendix D.II**.

Table II – Top Lifter Costing Analysis

Land Cost	$51,000.00
Equipment Cost	$122,713.00
Top Lifter Servicing 6.3 acres	$19,478.25
Acre Cost	$70,478.25

III. IMPLEMENTATION

Considering that one top lifter can service 224 containers, a total of 14 top lifters would have to be purchased to completely ground 3000 units of inventory (**Appendix B**). This would eliminate the wheeled storage chassis currently in use as well as the two existing gantry cranes. This is undesirable also due to financial concerns for having to find financial solutions for selling the cranes prior to paying them off.

B. GANTRY CRANE GROUNDED STORAGE ANALYSIS

Gantry cranes are resources that involve a large investment and serious consideration. They operate with a tradeoff between storage density and cost of operation. Despite their intimidating size they are surprisingly efficient. When comparing the amount of days that a container takes up space, gantry cranes are 88% more efficient in footprint usage than wheeled storage, despite requiring all needed space to be set-aside the moment the first containers arrive (**Appendix G**).

I. ADVANTAGES/DISADVANTAGES

By using gantry cranes ACME could store containers in a 3-high configuration to save money and allow much more storage capacity than both top lifters and wheeled storage. The land costs for Gantry Crane

would be exactly the same as the land costs for top lifters. The gantry crane container method not only achieves the optimal container cost in 3-high configuration, but also manages to outperform the top lifter method in 2-high configuration.

There are several concerns to consider as well. Gantry cranes are the most expensive equipment and have the most costly maintenance fee. It also is more expensive to store items in a 1-high configuration with a gantry crane than in wheeled storage. There is also an intangible loss in convenience. Gantry cranes not only take longer to stack and re-stack containers but also incur the cost of pavement repair which would require time and effort. While cranes are cost effective they are still a large investment that will require large responsibility to ensure usefulness.

II. COST ANALYSIS

The total land cost for the gantry crane method is $51,000.00 per acre. A yard gantry crane costs $1,400,000.00 and the loan is paid over a 15-year period. Implementing the annual payment formula, ACME would have to pay 248,712.47 per crane per year. In addition, each crane can service up to 6.48 acres and the maintenance and operations costs are $50,000 and $45,000.00, respectively. This brings the total cost per acre to $89,381.55. ACME's cost per container then becomes $57.46 for 1-high, $28.73 for 2-high, and $19.15 for 3-high.

Table III – Gantry Crane Costing Analysis

Land Cost	$51,000.00
Equipment Cost	$248,712.47
Crane Servicing 6.48 acres	$38,381.55
Acre Cost	$89,381.55

III. IMPLEMENTATION

Considering that one gantry crane can service, at maximum capacity, 1008 containers. If the current cranes were properly arranged they would operate at a project utilization of 99%, meaning that 3024 units of inventory would be grounded (24 more than needed) (**Appendix E**). By purchasing one more crane, project utilization would decrease from 99% to 74%, and adding two more cranes would lead to a utilization of 74% to 60%. ACME should purchase a single crane because while current demand can be handled by the current level of cranes, any expansion in demand would exceed their capacity. The new crane would be properly used because utilization above 66% guarantees at least a 2-high stack, which gives the crane a competitive advantage over wheeled.

C. HYBRID GROUNDED & WHEELED STORAGE

This method is based largely upon the system currently in use at EBT. It would divide up the facility's storage space between gantry crane grounded storage and wheeled storage. However, this plan changes the composition of the storage methods to largely replace wheeled storage with grounded storage.

I. ADVANTAGES/DISADVANTAGES

By using ground wheeled storage will be less restrained, will require less retooling, will be able to implement immediately. Hybrid storage has the lowest land cost. It also utilizes current resources more effectively. In the short run it is the cost effective. The greatest advantage of them all is investment: ACME will not have to invest any new capital and it would leave most of its operation running the same way.

However, ACME has been losing money by doing what they are doing today. If they continue to run things without changing anything it will allow continuation of a method that has led to inefficiency. Workers would have to consistently monitor the storage units to try to keep wheeled storage to a minimum and it will be less convenient and in the long. Unchecked, the increasing costs could bankrupt EBT.

II. COST ANALYSIS

The total land cost for wheeled storage is $40,000.00 per acre. There is no additional purchase of any equipment beyond the chassis at $400.00 per chassis-year. Assuming chassis cost is a yearly expense, it will cost ACME $21,263.62 per acre-cost. The total Acre cost considering land cost and chassis yearly expense comes to $61,263.62 per acre-year. ACME's cost per container is for 1-high is $37.89.

Table IV – Wheeled Storage Costing Analysis

Land Cost	$40,000.00
Equipment Cost	$21,263.62
Acre Cost	$61,263.62

III. IMPLEMENTATION

Implementation would consist of one major step: rearrangement of crane resources. Currently they are not at full operating capacity and this needs to be remedied. All that this entails is ensuring that each crane gets a full repeatable area's worth of space to itself.

IV. OTHER PROCESS RECOMMENDATIONS

Our recommended process improvements are very simple. Charge every container from ship to shore, shore to ship, or ship to ship $35.00, as per the standardized charge. Making sure that every container is charged avoids the situation of a competitor utilizing land shipping to treat EBT as a free storage facility.

We also recommend an additional $10 fine per outgoing container that is left at the facility past 5 days. ACME should do this because space is an expense. 77% of the containers are removed from ACME's property after the first 5 days. The other 33% take up space. Assuming that half the containers are outgoing, we generate an extra $150,562.50 per year (**Appendix I**).

V. CONCLUSIONS

EBT is currently suffering from three specific issues: failure to charge for non-dockside services, inefficient arrangement and usage of existing gantry cranes, and poor record keeping. By only charging for dockside services EBT has left itself open as a free ground storage facility. This not only limits the available capacity for profitable storage, but may actually be giving regional competitors an edge by allowing them to freely subcontract storage to the EBT facility. The inefficient arrangement of gantry cranes has wasted invested capital by not capitalizing on the increased efficiency and storage density available. Finally, poor record keeping has allowed these other two issues to become obstacles without alerting management to the specific issues at hand.

We recommend the following to improve these shortfalls for EBT. First, all containers should incur the standard storage cost when they enter the facility. This prevents the issue of providing free storage and also the possible time-loss of income due to extended storage before shipping. Second, the current cranes need to be rearranged so that their max capacity can be fully utilized. Each crane should have its own available repeatable area in one consistent column. Third, we recommend the purchase of one more gantry crane to move the facility into fully grounded storage. Any losses in stacking efficiency due to multiple cranes will be recouped by the significant gains in storage cost savings and future demand capacity. Finally, a record keeping initiative should be instituted at EBT to ensure that any future problems are more quickly recognized and dealt with.

VI. BIBLIOGRAPHY

(Citation according to MLA 7)

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